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# FLOOD INSURANCE STUDY

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## COUNTY OF ISANTI, MINNESOTA

### UNINCORPORATED AREAS

NOVEMBER 19, 1980

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY

COUNTY OF ISANTI, MINNESOTA
UNINCORPORATED AREAS

## 1.0 INTRODUCTION

### 1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the unincorporated areas of Isanti County, Minnesota, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the unincorporated areas of Isanti County to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.1 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

### 1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Edwards and Kelcey, Inc., for the Federal Insurance Administration, under Contract No. H-3983. This study was completed in July 1979.

### 1.3 Coordination

Streams requiring detailed and approximate study were identified at an initial coordination and time and cost meeting attended by representatives of the Minnesota Department of Natural Resources (Mn/DNR), the FIA, and Isanti County on March 10, 1976. Base maps were obtained from the Consultation Coordination Officer; the Isanti County Engineer; the Mn/DNR; Nason-Werhman-Chapman; the St. Paul District COE; and the U.S. Geological Survey (USGS). Flood elevations, flood boundaries, and floodway delineations were coordinated with Isanti County Engineers;

Nason-Werhman-Knight-Chapman; the St.Paul District COE; the Minnesota Department of Transportation; Mark Hurd Aerial Surveys; John W. Gorman, Inc.; the Isanti County Department of Planning and Zoning; the Isanti County Department of Civil Defense; the Mn/DNR; the Soil Conservation Service (SCS); and the USGS. Approval by the Inter-Agency Review Committee was received on October 21, 1977.

On March 26, 1980, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, the FIA, the State of Minnesota, and Isanti County.

## 2.0 AREA STUDIED

### 2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Isanti County. The area of study is shown on the Vicinity Map (Figure 1). The incorporated communities of the county were excluded from this study.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction for the next five years, through July 1984.

Approximate methods of analysis were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by the FIA and the unincorporated areas of Isanti County.

The flooding sources studied by detailed methods are listed below:

a. the Rum River, from the southern county boundary to about 2.5 miles upstream of the confluence of Isanti Brook, and from about 1.2 miles downstream of County Highway 14 to about 4.2 miles upstream of State Highway 47;

b. Isanti Brook, from about 1.5 miles downstream of County Road 43 to Florence Lake;

c. Florence Lake, within Isanti County;

d. Elms Lake, within Isanti County;

e. Lake Fannie, within Isanti County;

f. Skogman Lake, within Isanti County;

g. Green Lake, within Isanti County; and

h. Green Lake Brook, from Green Lake to the confluence with the Rum River.

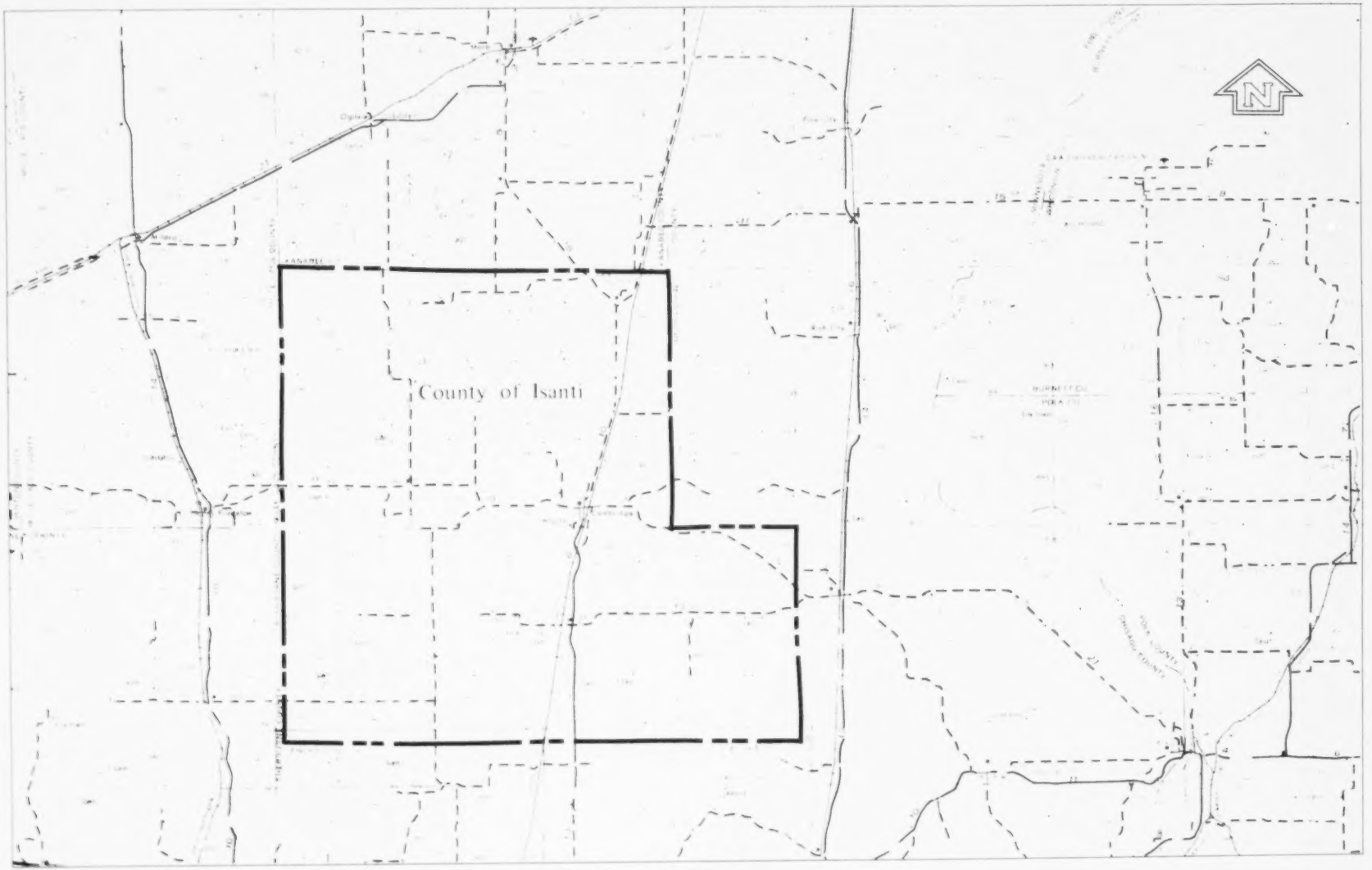


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

# COUNTY OF ISANTI, MN
(UNINCORPORATED AREAS)

APPROXIMATE SCALE

7 0 7 14 21 MILES

## VICINITY MAP

Flooding sources studied by approximate methods include the Rum River from about 2.5 miles upstream of the confluence of Isanti Brook to about 1.2 miles downstream of County Highway 14, and from about 2.8 miles upstream of State Highway 47 to the western county boundary; Isanti Brook from 0.8 mile upstream of the confluence with the Rum River to about 1.4 miles downstream of County Road 43; and Stanchfield Creek, Ties Creek, Cedar Creek, West Branch Sunrise River, North Branch Sunrise River, and numerous lakes, ponds, tributaries, and swamps throughout the county.

## 2.2 Community Description

Isanti County is located in east-central Minnesota, and is bordered on the north by Kanabec County, on the east by Chisago County, on the south by Anoka County, on the southwest by Sherburne County, and on the northwest by Mille Lacs County. The Cities of St. Francis and East Bethel are also located on the southern boundary in Anoka County. The City of Cambridge, which serves as the county seat, is situated along the Rum River, slightly east of the center of the county. Using this community as the focal point for the county, St. Paul is 40 miles south, Duluth is 100 miles northeast, and St. Cloud is 45 miles west. Settlement of the county proceeded slowly. The first census in 1860 reported only 284 inhabitants. By 1890, there were 7,607 persons, and in 1910, the population was 12,615. More recent population estimates are presented in the following table. The 1940, 1950, 1960, and 1970 estimates were taken from the U.S. Census Bureau (Reference 1) the 1977 estimate, prepared July 1, 1977, was taken from the Minnesota State Demographer (Reference 2).

| Year | Population | Percent Change |
|---|---|---|
| 1940 | 12,950 | |
| 1950 | 12,123 | -6 |
| 1960 | 13,530 | +12 |
| 1970 | 16,560 | +22 |
| 1977 | 20,400 | +23 |

The first Caucasians to enter what is now Isanti County were two French explorers, Radisson and Crosseliers. In 1655 and 1659, they recorded voyages on the stream now called the Rum River. This area was then the home of four tribes of Sioux Indians, known as the Isanyati or Isantees. Isanti County was established from parts of Ramsey and Benton Counties on February 13, 1857, and was named after the Isanyati Indians. The first settlement in the county, Spencer Brook, was founded by Benjamin Spencer in 1854. In 1856, the plat of Cambridge Village, a mile south of the present Town of Cambridge, was recorded and has served as the county seat since its beginning. The first school was built in the late 1850's and railroad service began in 1899.

The meteorological data contained in this report is taken from records maintained at the U.S. Weather Bureau station at the Cambridge State Hospital, Cambridge, Minnesota. The data was obtained from the Minnesota State Climatologist and represents the 1951-1974 averaging period. The climate associated with Isanti County is subhumid, characterized by wide seasonal variations in temperature, ample rainfall for crops, and moderate snowfall. Summers are warm and moderately humid, with occasional short periods of hot, very humid weather. Winters are cold and moderately humid. The average annual temperature is 42.0 degrees Fahrenheit (F.) with variation in monthly average temperatures from 9.7 degrees F. in January to 69.9 degrees F. in July. Temperature extremes range from a January low of -42 degrees F. to a July high of 109 degrees F. Annual precipitation averages 26.6 inches and has ranged from a low of 18.8 inches in 1933 to a high of 38.85 inches in 1938. Snowfall averages 44.6 inches annually (Reference 3).

Isanti County is comprised of six main soil associations occurring in a characteristic pattern on a characteristic type of landscape. The most extensive association in the county is the Zimmerman-Lino Association, which occupies the relatively smooth Anoka sand plain (Reference 4). In general, the topography is level to sloping, but narrow strips of soil on steeper slopes extend into the areas along the drainageways and around bogs. The Zimmerman and Lino soils were derived from sorted fine sand deposited during the retreat of the Mankato ice sheet. Natural drainage is excessive and the soils are commonly droughty; wind erosion is a serious hazard.

The Hayden-Bluffton Association occupies the undulating to rolling glacial till plain of the Mankato substage, which is at a somewhat higher elevation than the Anoka sand plain (Reference 4). The Hayden soils occupy the undulating parts of the till plain and are moderately well-drained with the steeper areas severely damaged by erosion. The Bluffton soils occur in wet depressions within areas of the Hayden soils.

The Milaca-Freer Association occupies the level to rolling glacial till plain of the Cary substage, and is not extensive within Isanti County (Reference 4). This association occurs only in the extreme northern and southwestern parts of the county. The Milaca soils are well-drained sandy loams and silty loams. The Freer soil is an imperfectly drained associate of the Milaca soils and occupies gentle depressions and flats on the upland till plain.

The Dalbo-Brickton Association occurs in the extreme northern part of Isanti County, as an area that was once occupied by the southern portion of glacial Lake Grantsburg (Reference 4). The Dalbo soils occupy the undulating and rolling areas on the lake plain and are moderately well-drained to well-drained. The Brickton soils occur on nearly level flats and its imperfect drainage characteristic often delays cultivation on the nearly level areas.

The Onamia-Chetek Association occurs in a few scattered areas in the northern part of the county along the Kanabec County border and in the southwestern corner (Reference 4). The Onamia soil is a well-drained fine sandy loam. The Chetek soils are excessively drained loamy sands.

Peat occurs throughout the county on both the sand plain and the till plains. The landscape of Isanti County is dominated by glacial and postglacial deposits, and is characterized by undulating and rolling morainic hills, outwash sand plains, old glacial lake beds, numerous bogs, lakes, dry stream channels, and barbed streams. There are no exposures of bedrock. The extensive Anoka sand plain, which covers about 60 percent of the county, is characterized by relatively smooth relief, fingerlike depressions, many small isolated bogs, and scattered dunelike knolls of wind-deposited materials (Reference 5). Several belts of morainic hills, formed from material deposited during one of the earlier glacial periods, extend across the county. One of the most prominent hills is located in the extreme southwestern corner of the county; the highest elevations in this region are associated with a series of ridges that rise abruptly to 100 feet or more above the sand plain. Another distinct morainic ridge occurs in Maple Ridge Township. The crest of this ridge, the highest point in the county, is 1,150 feet. Areas of rolling topography also occur in Stanchfield, Springvale, and Cambridge Townships (Reference 4).

Two kinds of glacial drift, of slightly different age and markedly different composition, have been deposited in the county. The older is the middle Wisconsin (Cary) drift, commonly called red drift because of the color of the unweathered material. This drift material was transported from the region around Lake Superior and Duluth by a glacier that advanced from the northeast. Red drift is stony, generally coarse textured, and low in lime (Reference 4). The more recent drift was deposited by the Grantsburg sublobe of the Des Moines lobe, which advanced from the northwest during the late Wisconsin (Mankato) glacial age. This material is gray when unweathered, and the deposits are commonly called gray drift. It is less stony than red drift and is normally fine textured. Except on a few isolated morainic hills, a thin layer of glacial till and outwash material of this later period overlies the older red drift.

The extensive stands of timber found throughout the county, first reported in the 1890's by a lumber cruiser named Daniel Stanchfield, attracted many lumbermen from the New England States and served as the county's first industry. By 1852, there were approximately 20 logging firms working in the county. The first crops grown in Isanti County were at North Branch in 1857. Potatoes became the most important crop as farming began to replace lumbering as the major industry for the county. In recent years, potato production has declined and dairying has become the dominant agricultural enterprise. Agriculture remains the principal occupation for the county and the main industries found in the county are associated with the processing and distribution of farm products or with sales and service to

farmers. Additional business activities include egg production, tree farming, and gravel and mineral extraction. Residential development that has occurred recently is dependent on employment available in the Minneapolis-St. Paul metropolitan area.

Nearly all of the county is drained by the Rum River, which enters Isanti County from the west, flows eastward to a point about 3 miles north of the City of Cambridge, and then southward into western Anoka County. The few natural tributaries that have developed in Isanti County are very shallow and inadequate drainage outlets. The main tributaries of the Rum River in Isanti County are Spencer Brook, Upper and Lower Stanchfield Creeks, and Cedar Creek. The southeastern part of the county is drained by the North Branch Sunrise River which flows eastward into the St. Croix River. Many lakes, ponds, and bogs provide the county with a large natural storage capacity. Isanti County is listed as having 145 lakes that encompass an area of 12,164 acres (Reference 5). The county is also documented as having nearly 10 percent, 26,400 acres, of its entire acreage, 293,000 acres, inundated by surface water from all contributing sources (Reference 2).

Due to the extensive agricultural use of the land, much of the development for the county has taken place in the various urban areas located within the county. Most of the flood plain development found in the unincorporated regions of Isanti County is limited to highway and railroad right-of-ways. Future development is projected to take place mostly in the incorporated areas, while smaller farms of 3 to 20 acres will replace the current, larger farms (Reference 5). There will also be an increase in the demand for lake shore property.

## 2.3 Principal Flood Problems

Flooding events occur in the spring and early summer. Runoff from heavy rains cannot utilize the extensive natural storage areas which are filled by snowmelt or earlier rainfall runoff. Due to the large storage capacity available in the numerous lakes and marshes throughout the basin, flooding conditions often prevail for several weeks.

Past flood information along the Rum River is mainly in the form of historic water-surface profiles compiled by the COE, high water marks tabulated for historic events by the COE and the USGS, and miscellaneous discharge measurements documented by the USGS (Reference 6).

Two of the most severe and recent historic flood events took place in 1965 and 1972. For those reaches of the Rum River upstream of Cambridge, Minnesota, the 1972 flood proved to be the more severe of the two. This flood was the result of a July rainstorm that was centered over the Rum River Watershed. The USGS documented a peak water-surface elevation of 930.47 feet on July 25, 1972, at the downstream side of the State Highway 47 bridge at West Point. The corresponding recorded peak discharge of

16,000 cubic feet per second (cfs) very nearly approximates the 100-year discharge of 16,100 cfs for this reach. Numerous downstream high water marks were recorded and employed during the calibration of the step-backwater model. The 1965 flood event proved to be the flood of record for the Rum River reaches downstream of Cambridge, Minnesota. This flood was the result of a rather rapid snowmelt augmented by two distinct periods of rainfall separated by an approximate two-week period.

The peak historic discharge of 10,100 cfs recorded at the USGS gaging station at St. Francis, Minnesota, approximated a 25-year frequency flood event. The high water elevations for this flood event were tabulated by the COE and proved invaluable in the calibration process.

Due to the lack of structural development within the flood plain, damages from these events were limited to destruction of agricultural products. A dollar estimate of damages is not available.

The abundance of natural watershed storage is the primary factor influencing flooding within the county. Storage adjacent to the stream channel is so extensive upstream of the City of Cambridge that a reduction in the flood flow frequency discharges occurs. Elimination of this storage will cause an increase in downstream discharges and a resultant increase in flood-related damages.

### 2.4 Flood Protection Measures

The only structural flood protection measure consists of a flap gate located on the downstream side of the crossing of State Highway 47 over Green Lake Brook. The flap gate prevents high water on the Rum River from backing up Green Lake Brook until it overtops the roadway. However, due to the relatively low embankment height of State Highway 47, all events with a return frequency greater than the 10-year event will overtop the roadway.

A high water overflow channel extends from the State Highway 95 crossing near Dalbo to a point upstream of the State Highway 47 crossing near West Point. This area includes significant floodwater storage and results in a significant decrease in downstream discharges. Water is released slowly over an extended period of time.

The divergence channel on the Rum River (approximately 3.56 miles upstream of State Highway 47) should remain clear and undeveloped. If this divergence channel were obstructed, flood levels on the Rum River would increase.

Several county judicial ditches drain the overflow area into the Rum River downstream of the City of Cambridge. The discharge in these ditches is limited by the hydraulic properties and does not result in significant flooding.

## 3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data

required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten), and for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

## 3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the county.

Available hydrologic data for this study included data recorded at a permanent USGS stream gaging station located on the Rum River near St. Francis, Minnesota, in Anoka County. Several isolated peak discharge values for the Rum River near the Cities of Spencer Creek and West Point were supplied by the USGS from records maintained at the St. Paul offices; the hydrologic analysis of the Rum River prepared for the Anoka County Flood Insurance Study was also utilized for this study (Reference 7).

Hydrologic analysis for the Rum River reaches, located downstream of the City of Cambridge and upstream of the Isanti County-Anoka County lines, involved the verification of the administrative discharge values determined by the USGS from various records and coordinated with the COE for the USGS gage station (no. 5-2860) located on the Rum River near St. Francis, Minnesota; it incorporates 45 years of record. A log-Pearson Type III analysis (WRC 17) was performed for the period of record, 1930 to 1975, to confirm that the administrative discharges were within the 95-percent confidence limits, as specified by the Flood Insurance Study Guidelines and Specifications (References 8 and 9). Flood flow frequencies were then computed by transferring the 10-, 50-, 100-, and 500-year administrative discharge values upstream from the gaging station at St. Francis; the general transfer relationship of the following equation was used.

$$Q_2 = Q_1 \quad (A_2/A_1)^{.60}$$

The hydrologic analysis for the Rum River reach upstream of Cambridge was greatly complicated by large storage effects and lack of historical hydrologic data. However, the documented historic events exemplify the impact of the storage effects on the discharge. In 1972, a peak discharge of 16,000 cfs was measured by the USGS at West Point, with a drainage area of 992 square miles compared to a peak discharge of 9,540 cfs at the stream gage near St. Francis with a drainage area of 1,360 square miles. While these values were produced by a storm system centered over the upstream watershed, they demonstrate the result of the storage effect on flood flows. Using the few discharges available on the Rum River near Spencer Brook and West Point, the average ratio of peak discharges was determined between the peak discharge at each gage site and the peak discharge for the same storm at the gage near St. Francis, Minnesota. The average ratio for discharges at Spencer Brook was 1.20, while the average ratio for discharges at West Point was 1.15. Therefore:

Q at Spencer Brook = 1.20 (Q at St. Francis gage)

Q at West Point = 1.15 (Q at St. Francis gage)

Drainage area-frequency-discharge curves were constructed using the 10-, 50-, 100-, and 500-year recurrence intervals for the Spencer Brook, West Point, and St. Francis stations. The curves reflect a decrease in discharge on the Rum River from Spencer Brook to a point just upstream of the confluence of the Rum River with Stanchfield Creek. This decrease is attributed to a flow diversion into the large storage area via a secondary bypass channel; the high water bifurcation point is located just upstream of West Point. Flood flow frequencies for the secondary channel were developed using a normal depth analysis of both the primary and secondary channels in this vicinity of the Rum River. The discharge split was found by matching energy grade lines at the upstream and downstream bifurcation points. From this point, discharges increase due to the substantial increase in tributary area from Upper Stanchfield Creek, Lower Stanchfield Creek, Isanti Brook, Seelye Brook, and Cedar Creek watersheds.

The hydrologic analysis for Green Lake and Green Lake Brook was found to be interrelated with the hydraulics of the Rum River near the Green Lake Brook outlet. Development of water-surface elevations for the Rum River near its confluence with Green Lake Brook was necessary for the Green Lake study due to the fact that floodwaters from the Rum River inundate the two discharge structures (located at State Highway 47 and CSAH 7). These provide the conveyance of the Green Lake Brook discharges from Green Lake to the Rum River. High water on the Rum River further complicates the hydrologic situation in this area due to a flap gate that is located on the downstream side of the crossing of State Highway 47 with Green Lake Brook. This flap gate prevents high water on the Rum River

from backing up Green Lake Brook until the elevations attained by the Rum River are such that they overtop State Highway 47. Therefore, no outflow from Green Lake Brook is considered possible when high water on the Rum River prevails.

The SCS TR-20 hydrologic model was used to analyze Green Lake with the assumption of free outflow from the lake's outlet structure located at the CSAH 7 crossing (Reference 10). A rating curve for the outlet structure was computed by developing the water-surface profiles for Green Lake Brook and a storage-elevation curve developed from lake mapping from the Department of Natural Resources and USGS quadrangle mapping (Reference 11). Due to the duration of backwater effects from the Rum River and the amount of storage located adjacent to Green Lake, a 10-day runoff event was used in the TR-20 computations. A combination of the runoff from the Green Lake-Green Lake Brook watershed and the backwater from the Rum River indicated that the flood elevations for Green Lake would be the same as the 10-, 50-, 100-, and 500-year elevations on the Rum River near the Green Lake Brook confluence. This computation was substantiated by historical observations from the Isanti County Civil Defense Officer.

The hydrologic analysis for the Isanti Brook lakes area study utilized the SCS TR-20 hydrologic model to route flood runoff through Skogman Lake, Lake Fannie, Elms Lake, and Florence Lake (Reference 10). The HEC-2 water-surface profile program was used to develop normal depth channel rating curves at the outlet of each of the four lakes (Reference 12). Storage-elevation curves were calculated using Department of Natural Resources lake mapping and USGS quadrangle maps (References 11 and 13). Due to the large amount of available storage and the relatively long time of concentration, the 10-day runoff event was used to compute discharges and elevations for each of the lakes. Elms Lake and Florence Lake are connected by an unregulated channel and their 10-, 50-, 100-, and 500-year flood elevations were found to be the same. Due to its larger tributary area, the results of the TR-20 analysis indicated that these water-surface elevations on Lake Fannie were higher than those of Skogman Lake. However, the water-surface levels on the two lakes reach equilibrium and, therefore, the 10-, 50-, 100-, and 500-year elevations for Lake Fannie and Skogman Lake were found by combining the storage elevation curves for the lakes and applying the total quantity of water for the subwatersheds to the combined storage-elevation curves. Respective elevations are shown in Table 1, Summary of Elevations.

All of the discharge values proposed for use in computing HEC-2 water-surface elevations for the various detailed riverine study reaches were submitted for review to a state inter-agency review committee comprised of the Minnesota Department of Natural Resources, the SCS, the USGS, and the St. Paul District COE. Acceptance of the proposed discharge values was

transmitted via letter dated October 21, 1977. This acceptance also included the proposed water-surface levels for the various return frequencies of the lakes studied with detailed methodology.

TABLE 1 - SUMMARY OF ELEVATIONS

| LOCATION | ELEVATIONS (NGVD) 10-YEAR | 50-YEAR | 100-YEAR | 500-YEAR |
|---|---|---|---|---|
| Florence Lake | 946.5 | 947.6 | 948.1 | 948.6 |
| Elms Lake | 946.5 | 947.6 | 948.1 | 948.6 |
| Lake Fannie | 946.8 | 948.1 | 948.7 | 950.2 |
| Skogman Lake | 946.8 | 948.1 | 948.7 | 950.2 |
| Green Lake | 927.4 | 928.3 | 929.0 | 930.5 |

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 2.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the county were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross sections for the backwater analyses were field surveyed and were located at close intervals above and below bridges and culverts in order to compute significant backwater effects in the developing areas. Input data for the Rum River were supplemented with cross section data obtained by the USGS for the Anoka County Flood Insurance Study (Reference 7). Bridge plans for the new County Highway No. 10 bridge, County Highway No. 5, and County Highway No. 14 were also obtained, and supplied the necessary geometric dimensions required for input data to the hydraulic model.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

TABLE 1 - SUMMARY OF DISCHARGES

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA SQ MILES | PEAK DISCHARGES (CFS) 10-YEAR | 50-YEAR | 100-YEAR | 500-YEAR |
|---|---|---|---|---|---|
| RUM RIVER | | | | | |
| Isanti County-Anoka County line | 1,295 | 8,080 | 11,900 | 13,600 | 17,600 |
| Upstream of confluence of Isanti Brook | 1,213 | 7,700 | 11,400 | 13,100 | 16,900 |
| 1.2 miles downstream of County Highway 14 | 1,143 | 7,450 | 10,900 | 12,600 | 16,300 |
| 2.5 miles upstream of County Highway 14 | 1,051 | 8,100 | 11,800 | 13,600 | 17,800 |
| At State Highway 95, located 350 feet downstream of County Highway 1 | 1,037 | 8,600 | 12,500 | 14,300 | 18,800 |
| At State Highway 47 | 992 | 9,540 | 14,000 | 16,100 | 20,800 |
| ISANTI BROOK | | | | | |
| Florence Lake Outlet | 14.6 | 184 | 237 | 255 | 289 |

On the Rum River downstream of Cambridge, loss coefficients for bridges and other channel obstructions, along with channel and overbank roughness coefficients (Manning's "n"), were initially estimated by field inspection. Calibration of the COE HEC-2 hydraulic model was obtained by computing a water-surface profile using the historic, approximately 25-year frequency 1965 discharge (Reference 10). The elevations obtained by this procedure were then compared against those recorded at miscellaneous gage sites during the 1965 flood. The coefficients were adjusted until satisfactory agreement was arrived at between the computed water-surface elevations and the 1965 historic high water marks. Manning's "n" values for the channel varied between 0.03 and 0.04, while Manning's "n" values for the overbanks varied from 0.03 to 0.15.

On the Rum River reach upstream of Cambridge, loss coefficients for bridges and other channel obstructions, along with channel and overbank roughness coefficients (Manning's "n"), were initially estimated by field inspection. Calibration of the HEC-2 hydraulic model was obtained by computing the water-surface profile using the historic 1972 discharge; this was approximately the 100-year event (Reference 12). The elevations obtained by this procedure were then compared against those recorded at miscellaneous sites and aerial photography taken during the 1972 flood event. The coefficients were adjusted until satisfactory agreement was arrived at between the computed water-surface elevations and the 1972 historic high water marks. Manning's "n" values for the channel varied between 0.028 and 0.038, while Manning's "n" values for the overbanks varied from 0.028 to 0.11.

On Isanti Brook, loss coefficients for bridges and other channel obstructions, along with channel and overbank roughness coefficients (Manning's "n"), were initially estimated by field inspection. Since the frequency discharge values used in computing the water-surface profiles are dependent on the relationship between the elevations attained by Florence Lake and the rating curve for the outflow structure, minor adjustments to the initial coefficients were made so that the various frequency water-surface elevations computed at the very upstream limit of Isanti Brook (i.e., the outflow structure) would be consistent with those reflected by the various frequency lake levels for Florence Lake. Manning's "n" values for the channel varied between 0.025 and 0.045, while Manning's "n" values for the overbanks varied from 0.041 to 0.087.

Starting water-surface elevations for the Rum River reach downstream of Cambridge were taken from the Anoka County Flood Insurance Study (Reference 7). Starting water-surface elevations for the Rum River reach upstream of Cambridge and Isanti Brook were computed by the energy slope-cross sectional area method.

Water-surface profiles for the various frequency floods on the stream reaches studied in detail, were computed using the HEC-2 step-backwater computer program (Reference 10). Computation of water-surface profiles for the 10-, 50-, 100-, and 500-year discharges on the Rum River (primary channel) at West Point was completed using the HEC-2 computer program and the respective discharges from the drainage area-frequency discharge curves (Reference 12). The hydraulic model was calibrated using several historic high water elevations and discharges at West Point.

The portion of Isanti Brook found between Elms Lake and Lake Fannie serves to convey supplemental storage between the two lakes. This storage area is divided into two distinct areas of storage by County Road 45. A TR-20 analysis provided the necessary computations for the various frequency elevations for the two adjacent lakes (Reference 10). With County Road 45 acting as a levee, the upstream storage area will assume the same elevations tabulated for Lake Fannie while the downstream storage area will assume the same elevations asociated with Elms Lake. Losses computed via culvert nomographs were used to validate the water-surface elevation (Reference 14).

Hydraulic analysis for Green Lake Brook was calculated by a TR-20 analysis carried out for the hydrologic computations (Reference 10). The 10-, 50-, 100-, and 500-year elevations for Green Lake Brook will be the same as the corresponding frequency elevations computed for the Rum River near the Green Lake Brook confluence. Due to the nature of flooding (i.e., backwater), a profile was not prepared for this stream reach.

The HEC-2 water-surface profile program (Reference 8) was used to develop normal depth channel rating curves at the outlets of Lake Skogman, Lake Fannie, Elms Lake, and Florence Lake. Storage-elevation curves were then calculated using Mn/DNR lake mapping and USGS maps (References 11 and 13).

The flood profiles were computed on the basis of full hydraulic efficiency of the stream channels and structures, without consideration of the effects of obstruction. While such obstructions can be the cause of flooding in localized areas, the frequency of occurrence of such obstructions is unpredictable. Flow in overbank areas was subject to an effective flow analysis; areas outside the effective flow limits and below the flood elevations were considered to be in storage. Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

Approximate 100-year elevations for the Rum River downstream of Cambridge were developed by the COE from the 1965 flood event (Reference 6). Approximate 100-year elevations for the Rum River upstream of Cambridge and West Point were developed by the COE from the

1972 flood event. Approximate 100-year flood boundaries for the remaining streams studied by approximate methods were computed using a combination of normal depth analysis at strategic locations, determination of soil classifications which are flood prone by the Mn/DNR and a direct transfer from the Soil Survey of Isanti County, Minnesota (Reference 4) and, USGS Flood Prone Area Maps (Reference 15). The flood elevations for the lakes studied were also computed on the basis of full hydraulic efficiency of the lakes' outlet structures and channels.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

## 4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

### 4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using USGS topographic mapping enlarged to a scale of 1:6000, with contour intervals of 10 and 20 feet (References 9 and 11). This mapping was supplemented by the valley and channel sections determined during the surveying effort to insure accuracy. The delineations were then photoreduced to a scale of 1:18000. This method of delineations adequately reflects conditions along the detailed study reaches. The approximate delineations were made utilizing soils maps photoenlarged to a scale of 1:12000 (Reference 4), and the published Flood Hazard Boundary Map (Reference 16), and USGS flood prone area maps (Reference 15) photoenlarged to 1:12000.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

## 4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. In Minnesota, however, flood plain encroachment is limited by Minnesota Regulations to that which would cause a 0.5-foot increase in flood heights above prefloodway conditions at any point (Reference 17). Floodways having no more than a 0.5-foot surcharge were delineated for this study.

The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 3).

The county has designated a political floodway encompassing the entire 100-year flood plain for all detailed study reaches. It is the intention of the county to establish and enforce a single district flood plain zoning ordinance, and the designated floodway will provide them with the technical data needed to enforce this ordinance. An engineered floodway, based on equal and opposite loss of conveyance, was established for all detailed study reaches. There are no other existing floodways within unincorporated Isanti County.

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.5 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQ. FEET) | MEAN VELOCITY (FEET/SEC.) | REGULATORY (NGVD) | WITHOUT FLOODWAY (NGVD) | WITH FLOODWAY (NGVD) | INCREASE (FEET) |
| RUM RIVER | | | | | | | | |
| A | 140,613 | 520/ 480[2] | 7135 | 1.91 | 905.5 | 905.5 | 905.5 | 0.0 |
| B | 142,593 | 1230 | 15,407 | 0.88 | 905.8 | 905.8 | 905.8 | 0.0 |
| C | 144,293 | 795 | 8706 | 1.56 | 906.0 | 906.0 | 906.0 | 0.0 |
| D | 145,183 | 390 | 4830 | 2.82 | 906.1 | 906.1 | 906.1 | 0.0 |
| E | 145,573 | 368 | 3833 | 3.55 | 906.3 | 906.3 | 906.3 | 0.0 |
| F | 146,391 | 445 | 5653 | 2.41 | 906.6 | 906.6 | 906.6 | 0.0 |
| G | 148,721 | 1020 | 12,527 | 1.09 | 907.0 | 907.0 | 907.0 | 0.0 |
| H | 151,271 | 1435 | 16,817 | 0.81 | 907.2 | 907.2 | 907.2 | 0.0 |
| I | 153,091 | 1530 | 13,480 | 1.01 | 907.3 | 907.3 | 907.3 | 0.0 |
| J | 155,591 | 1790 | 19,161 | 0.71 | 907.5 | 907.5 | 907.5 | 0.0 |
| K | 157,421 | 1400 | 16,101 | 0.84 | 907.6 | 907.6 | 907.6 | 0.0 |
| L | 158,781 | 1320 | 16,981 | 0.80 | 907.7 | 907.7 | 907.7 | 0.0 |
| M | 159,901 | 1260 | 16,142 | 0.57 | 907.7 | 907.7 | 907.7 | 0.0 |
| N | 161,311 | 1035 | 10,382 | 1.29 | 907.8 | 907.8 | 907.8 | 0.0 |
| O | 163,121 | 480 | 4426 | 3.03 | 908.0 | 908.0 | 908.0 | 0.0 |
| P | 165,068 | 570 | 4639 | 2.89 | 908.5 | 908.5 | 908.5 | 0.0 |
| Q | 167,014 | 750 | 4762 | 2.82 | 909.0 | 909.0 | 909.0 | 0.0 |
| R | 168,961 | 390 | 4909 | 2.73 | 909.4 | 909.4 | 909.4 | 0.0 |
| S | 169,961 | 710 | 9534 | 1.41 | 909.7 | 909.7 | 909.7 | 0.0 |
| T | 171,101 | 1155 | 3157 | 4.24 | 909.8 | 909.8 | 909.8 | 0.0 |
| U | 172,451 | 900 | 11,797 | 1.13 | 910.3 | 910.3 | 910.3 | 0.0 |
| V | 174,011 | 1800 | 10,825 | 1.24 | 910.4 | 910.4 | 910.4 | 0.0 |
| W | 175,491 | 1470 | 17,922 | 0.75 | 910.6 | 910.6 | 910.6 | 0.0 |
| X | 178,031 | 1590 | 16,041 | 0.84 | 910.7 | 910.7 | 910.7 | 0.0 |
| Y | 179,611 | 2610/2150[2] | 15,772 | 0.85 | 910.8 | 910.8 | 910.8 | 0.0 |
| Z | 180,841 | 1800 | 15,033 | 0.89 | 910.8 | 910.8 | 910.8 | 0.0 |

[1]FEET ABOVE CONFLUENCE WITH MISSISSIPPI RIVER
[2]TOTAL WIDTH / WIDTH WITHIN UNINCORPORATED AREA

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

**COUNTY OF ISANTI, MN**
**(UNINCORPORATED AREAS)**

**FLOODWAY DATA**

**RUM RIVER**

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQ. FEET) | MEAN VELOCITY (FEET/SEC.) | REGULATORY (NGVD) | WITHOUT FLOODWAY (NGVD) | WITH FLOODWAY (NGVD) | INCREASE (FEET) |
| RUM RIVER | | | | | | | | |
| AA | 181,741 | 1500 | 11,345 | 1.18 | 910.9 | 910.9 | 910.9 | 0.0 |
| AB | 183,431 | 940/760[2] | 10,340 | 1.30 | 911.1 | 911.1 | 911.1 | 0.0 |
| AC | 184,901 | 1270 | 10,674 | 1.26 | 911.3 | 911.3 | 911.3 | 0.0 |
| AD | 187,101 | 930 | 11,957 | 1.12 | 911.6 | 911.6 | 911.6 | 0.0 |
| AE | 188,221 | 910 | 9283 | 1.44 | 911.7 | 911.7 | 911.7 | 0.0 |
| AF | 189,801 | 400 | 4191 | 3.13 | 912.0 | 912.0 | 912.0 | 0.0 |
| AG | 191,961 | 1560 | 3804 | 3.44 | 912.8 | 912.8 | 912.8 | 0.0 |
| AH | 195,291 | 1170 | 11,171 | 1.17 | 913.5 | 913.5 | 913.5 | 0.0 |
| AI | 201,376 | 455 | 6897 | 1.89 | 914.5 | 914.5 | 914.5 | 0.0 |
| AJ | 261,321 | 816 | 2754 | 4.58 | 916.3 | 916.3 | 916.3 | 0.0 |
| AK | 263,401 | 489 | 2477 | 5.09 | 916.8 | 916.8 | 916.8 | 0.0 |
| AL | 265,401 | 650 | 3324 | 3.79 | 917.5 | 917.5 | 917.5 | 0.0 |
| AM | 266,561 | 385 | 2756 | 4.57 | 917.7 | 917.7 | 917.7 | 0.0 |
| AN | 267,509 | 320 | 2402 | 5.25 | 918.0 | 918.0 | 918.0 | 0.0 |
| AO | 267,821 | 420 | 2235 | 5.64 | 918.6 | 918.6 | 918.6 | 0.0 |
| AP | 270,501 | 480 | 3449 | 3.65 | 919.9 | 919.9 | 919.9 | 0.0 |
| AQ | 273,281 | 860 | 4858 | 2.59 | 920.5 | 920.5 | 920.5 | 0.0 |
| AR | 275,251 | 610 | 3741 | 3.37 | 920.8 | 920.8 | 920.8 | 0.0 |
| AS | 276,861 | 1220 | 3298 | 3.82 | 921.3 | 921.3 | 921.3 | 0.0 |
| AT | 278,411 | 1680 | 6179 | 2.04 | 921.8 | 921.8 | 921.8 | 0.0 |
| AU | 280,021 | 1900 | 3830 | 3.29 | 922.0 | 922.0 | 922.0 | 0.0 |
| AV | 280,065 | 1920 | 17,274 | 0.73 | 922.3 | 922.3 | 922.3 | 0.0 |
| AW | 282,941 | 2600 | 19,773 | 0.69 | 922.3 | 922.3 | 922.3 | 0.0 |
| AX | 285,591 | 2640 | 11,056 | 1.23 | 922.4 | 922.4 | 922.4 | 0.0 |
| AY | 286,891 | 2600 | 7954 | 1.71 | 922.5 | 922.5 | 922.5 | 0.0 |
| AZ | 289,871 | 3870 | 7831 | 1.73 | 922.9 | 922.9 | 922.9 | 0.0 |

[1]FEET ABOVE CONFLUENCE WITH MISSISSIPPI RIVER
[2]TOTAL WIDTH / WIDTH WITHIN UNINCORPORATED AREA

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

# COUNTY OF ISANTI, MN
(UNINCORPORATED AREAS)

## FLOODWAY DATA

## RUM RIVER

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQ. FEET) | MEAN VELOCITY (FEET/SEC.) | REGULATORY (NGVD) | WITHOUT FLOODWAY (NGVD) | WITH FLOODWAY (NGVD) | INCREASE (FEET) |
| RUM RIVER | | | | | | | | |
| BA | 292,371 | 4410 | 21,133 | 0.64 | 923.2 | 923.2 | 923.2 | 0.0 |
| BB | 295,731 | 4060 | 17,778 | 0.76 | 923.3 | 923.3 | 923.3 | 0.0 |
| BC | 297,911 | 2890 | 21,506 | 0.63 | 923.4 | 923.4 | 923.4 | 0.0 |
| BD | 302,491 | 2420 | 13,099 | 1.04 | 923.5 | 923.5 | 923.5 | 0.0 |
| BE | 303,901 | 2910 | 8387 | 1.62 | 923.6 | 923.6 | 923.6 | 0.0 |
| BF | 309,849 | 2680 | 15,668 | 0.92 | 925.2 | 925.2 | 925.2 | 0.0 |
| BG | 311,509 | 2691 | 20,450 | 0.70 | 925.3 | 925.3 | 925.3 | 0.0 |
| BH | 313,049 | 2508 | 17,336 | 0.83 | 925.3 | 925.3 | 925.3 | 0.0 |
| BI | 315,409 | 3234 | 22,635 | 0.63 | 925.4 | 925.4 | 925.4 | 0.0 |
| BJ | 318,609 | 3180 | 17,849 | 0.80 | 925.4 | 925.4 | 925.4 | 0.0 |
| BK | 320,039 | 3090 | 15,242 | 0.94 | 925.5 | 925.5 | 925.5 | 0.0 |
| BL | 322,379 | 2760 | 12,881 | 1.11 | 925.6 | 925.6 | 925.6 | 0.0 |
| BM | 324,209 | 1490 | 8768 | 1.63 | 925.8 | 925.8 | 925.8 | 0.0 |
| BN | 328,849 | 1250 | 5873 | 2.32 | 926.7 | 926.7 | 926.7 | 0.0 |
| BO | 330,999 | 2376 | 3411 | 4.20 | 927.5 | 927.5 | 927.5 | 0.0 |
| BP | 332,399 | 2169 | 4267 | 3.35 | 928.6 | 928.6 | 928.6 | 0.0 |
| BQ | 334,489 | 1320 | 3328 | 4.30 | 929.3 | 929.3 | 929.3 | 0.0 |
| BR | 336,891 | 390 | 2687 | 5.99 | 931.0 | 931.0 | 931.0 | 0.0 |
| BS | 337,331 | 816 | 5146 | 3.13 | 931.9 | 931.9 | 931.9 | 0.0 |
| BT | 339,761 | 1014 | 8852 | 1.82 | 932.5 | 932.5 | 932.5 | 0.0 |
| BU | 341,031 | 1386 | 7625 | 2.11 | 932.7 | 932.7 | 932.7 | 0.0 |
| BV | 343,351 | 1944 | 7154 | 2.25 | 933.2 | 933.2 | 933.2 | 0.0 |
| BW | 347,491 | 2484 | 12,865 | 1.25 | 933.8 | 933.8 | 933.8 | 0.0 |
| BX | 349,981 | 1341 | 7073 | 2.28 | 933.9 | 933.9 | 933.9 | 0.0 |
| BY | 351,191 | 1560 | 9077 | 1.77 | 934.3 | 934.3 | 934.3 | 0.0 |
| BZ | 352,841 | 2300 | 8903 | 1.81 | 934.5 | 934.5 | 934.5 | 0.0 |
| CA | 355,951 | 3690 | 11,679 | 1.38 | 934.7 | 934.7 | 934.7 | 0.0 |
| CB | 359,161 | 2610 | 5904 | 2.73 | 935.4 | 935.4 | 935.4 | 0.0 |

[1]FEET ABOVE CONFLUENCE WITH MISSISSIPPI RIVER

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

**COUNTY OF ISANTI, MN**
**(UNINCORPORATED AREAS)**

**FLOODWAY DATA**

**RUM RIVER**

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQ. FEET) | MEAN VELOCITY (FEET/SEC.) | REGULATORY (NGVD) | WITHOUT FLOODWAY (NGVD) | WITH FLOODWAY (NGVD) | INCREASE (FEET) |
| ISANTI BROOK | | | | | | | | |
| A | 5213 | 636 | 44 | 5.76 | 935.4 | 935.4 | 935.4 | 0.0 |
| B | 6223 | 180 | 172 | 1.48 | 938.2 | 938.2 | 938.2 | 0.0 |
| C | 7773 | 185 | 87 | 2.92 | 940.7 | 940.7 | 940.7 | 0.0 |
| D | 8560 | 262 | 127 | 2.02 | 942.6 | 942.6 | 942.6 | 0.0 |
| E | 8680 | 249 | 99 | 2.57 | 942.9 | 942.9 | 942.9 | 0.0 |
| F | 9273 | 69 | 146 | 1.74 | 943.5 | 943.5 | 943.5 | 0.0 |
| G | 9953 | 192 | 129 | 1.97 | 947.3 | 947.3 | 947.3 | 0.0 |
| H | 10,653 | 102 | 287 | 0.89 | 947.4 | 947.4 | 947.4 | 0.0 |
| I | 11,213 | 168 | 633 | 0.40 | 947.5 | 947.5 | 947.5 | 0.0 |
| J | 11,823 | 300 | 1437 | 0.17 | 947.5 | 947.5 | 947.5 | 0.0 |
| K | 12,658 | 276 | 1008 | 0.25 | 947.5 | 947.5 | 947.5 | 0.0 |

[1]FEET ABOVE COUNTY HIGHWAY 19

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

# COUNTY OF ISANTI, MN
(UNINCORPORATED AREAS)

## FLOODWAY DATA

## ISANTI BROOK

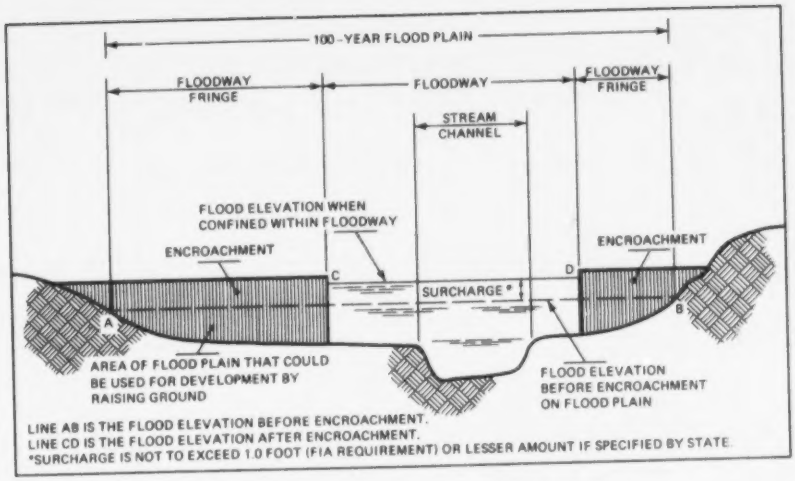
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE *
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 2 - Floodway Schematic

## 5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the unincorporated areas of Isanti County.

### 5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

| Average Difference Between 10- and 100-year Floods | Variation |
|---|---|
| Less than 2 feet | 0.5 foot |
| 2 to 7 feet | 1.0 foot |
| 7.1 to 12 feet | 2.0 feet |
| More than 12 feet | 3.0 feet |

The locations of the reaches determined for the unincorporated areas of Isanti County are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 4).

## 5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

## 5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the unincorporated areas of Isanti County were divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

| | |
|---|---|
| Zone A: | Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined. |
| Zones A1-A5, A10: | Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF. |
| Zone B: | Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided. |
| Zone C: | Areas of minimal flooding. |

Table 4, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

| FLOODING SOURCE | PANEL[1] | ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND | | | FLOOD HAZARD FACTOR | ZONE | BASE FLOOD ELEVATION[3] (NGVD) |
|---|---|---|---|---|---|---|---|
| | | 10% (10-YEAR) | 2% (50-YEAR) | 0.2% (500-YEAR) | | | |
| RUM RIVER | | | | | | | |
| REACH 1 | 0060,0065,0080 | –4.9 | –1.1 | 2.4 | 050 | A10 | VARIES–SEE MAP |
| REACH 2 | 0025,0030,0040 | –4.2 | –1.3 | 2.5 | 040 | A8 | VARIES–SEE MAP |
| REACH 3 | 0035,0040 | –1.8 | –0.6 | 1.8 | 020 | A4 | VARIES–SEE MAP |
| REACH 4 | 0035 | –2.6 | –0.9 | 1.5 | 025 | A5 | VARIES–SEE MAP |
| REACH 5 | 0035 | –2.0 | –0.6 | 1.4 | 020 | A4 | VARIES–SEE MAP |
| ISANTI BROOK | | | | | | | |
| REACH 1 | 0045,0065 | –0.4 | –0.1 | 0.1 | 005 | A1 | VARIES–SEE MAP |
| REACH 2 | 0045 | –1.0 | –0.5 | 0.8 | 010 | A2 | VARIES–SEE MAP |
| FLORENCE LAKE | | | | | | | |
| REACH 1 | 0045 | –1.6 | –0.5 | 0.5 | 015 | A3 | 948 |
| ELMS LAKE | | | | | | | |
| REACH 1 | 0045 | –1.6 | –0.5 | 0.5 | 015 | A3 | 948 |

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

**COUNTY OF ISANTI, MN**
**(UNINCORPORATED AREAS)**

## FLOOD INSURANCE ZONE DATA

**RUM RIVER - ISANTI BROOK - FLORENCE LAKE - ELMS LAKE**

| FLOODING SOURCE | PANEL[1] | ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND | | | FLOOD HAZARD FACTOR | ZONE | BASE FLOOD ELEVATION[3] (NGVD) |
|---|---|---|---|---|---|---|---|
| | | 10% (10-YEAR) | 2% (50-YEAR) | 0.2% (500-YEAR) | | | |
| LAKE FANNIE | | | | | | | |
| REACH 1 | 0045 | −1.9 | −0.6 | 1.5 | 020 | A4 | 949 |
| SKOGMAN LAKE | | | | | | | |
| REACH 1 | 0045 | −1.9 | −0.6 | 1.5 | 020 | A4 | 949 |
| GREEN LAKE | | | | | | | |
| REACH 1 | 0035 | −1.6 | −0.6 | 1.6 | 015 | A3 | 929 |
| GREEN LAKE BROOK | | | | | | | |
| REACH 1 | 0035 | −1.6 | −0.6 | 1.6 | 015 | A3 | 929 |

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

**COUNTY OF ISANTI, MN**
**(UNINCORPORATED AREAS)**

## FLOOD INSURANCE ZONE DATA

## LAKE FANNIE - SKOGMAN LAKE - GREEN LAKE - GREEN LAKE BROOK

## 5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the unincorporated areas of Isanti County is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

# 6.0 OTHER STUDIES

The USGS has obtained scattered surveyed field data concerning stage-discharge relationships at several locations throughout the watershed, as well as a permanent gage located at St. Francis, Minnesota. This information was obtained during the reconnaissance phase of the study and was utilized during the hydrology and hydraulics efforts.

The St. Paul District COE established high water marks at various locations throughout the watershed for the 1965 and 1972 flood events; these are considered the floods of record. They also field surveyed valley cross sections through the reach from St. Francis to Spencer Brook. These data were used in preparing historic water-surface profiles of the 1965 and 1972 flood events. These profiles and related discharges were used to calibrate the hydraulic model prepared for this study. Agreement with this historical data is thus assured.

The hydraulic model for the Rum River was obtained for the area contiguous to Isanti County from the Anoka County Flood Insurance Study (Reference 7). The model for a portion of the downstream reach of the Rum River from that study was used directly in this study, incorporating the water-surface elevations, flood flow frequency discharges, and valley cross sections. A portion of the model was revised to reflect changed bridge hydraulic properties. The coordination effort insured compatibility between studies.

In 1972, the Minnesota Department of Natural Resources commissioned Mark Hurd Aerial Surveys to obtain aerial photographs of the 1972 flood event on the Rum River. These photos were used to determine effective flow limits and flood plain delineations (Reference 18).

An approximate study was prepared for the Sherburne County Flood Insurance Study which was obtained to insure compatibility between studies at the corporate limit (Reference 19). This study agrees with the Flood Insurance Studies for Anoka County, Sherburne County, and the City of Cambridge (References 7, 19, and 20).

A Flood Hazard Boundary Map has been published by the Federal Insurance Administration (Reference 16). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

## 7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, One North Dearborn Street, Chicago, Illinois 60602.

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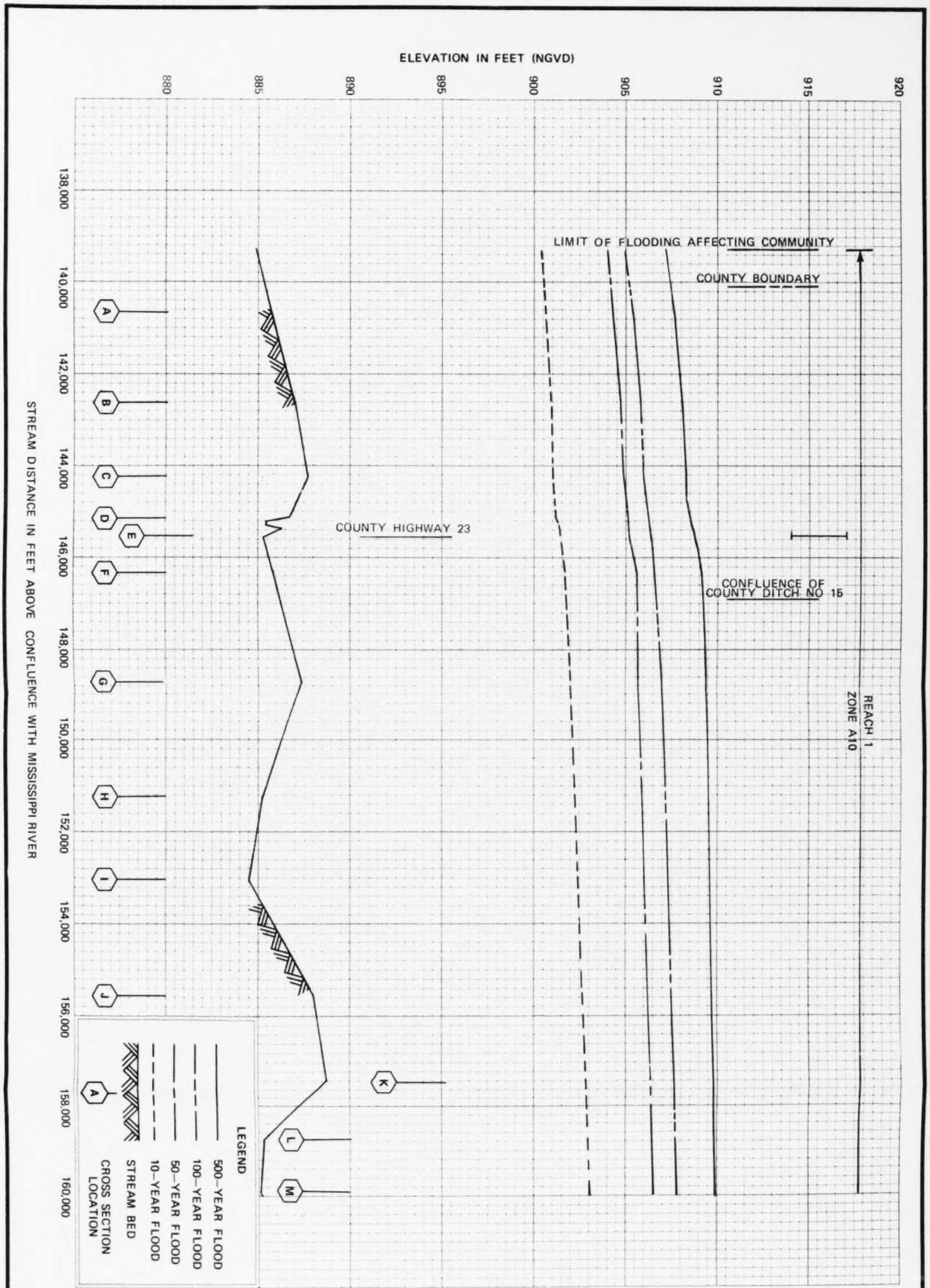


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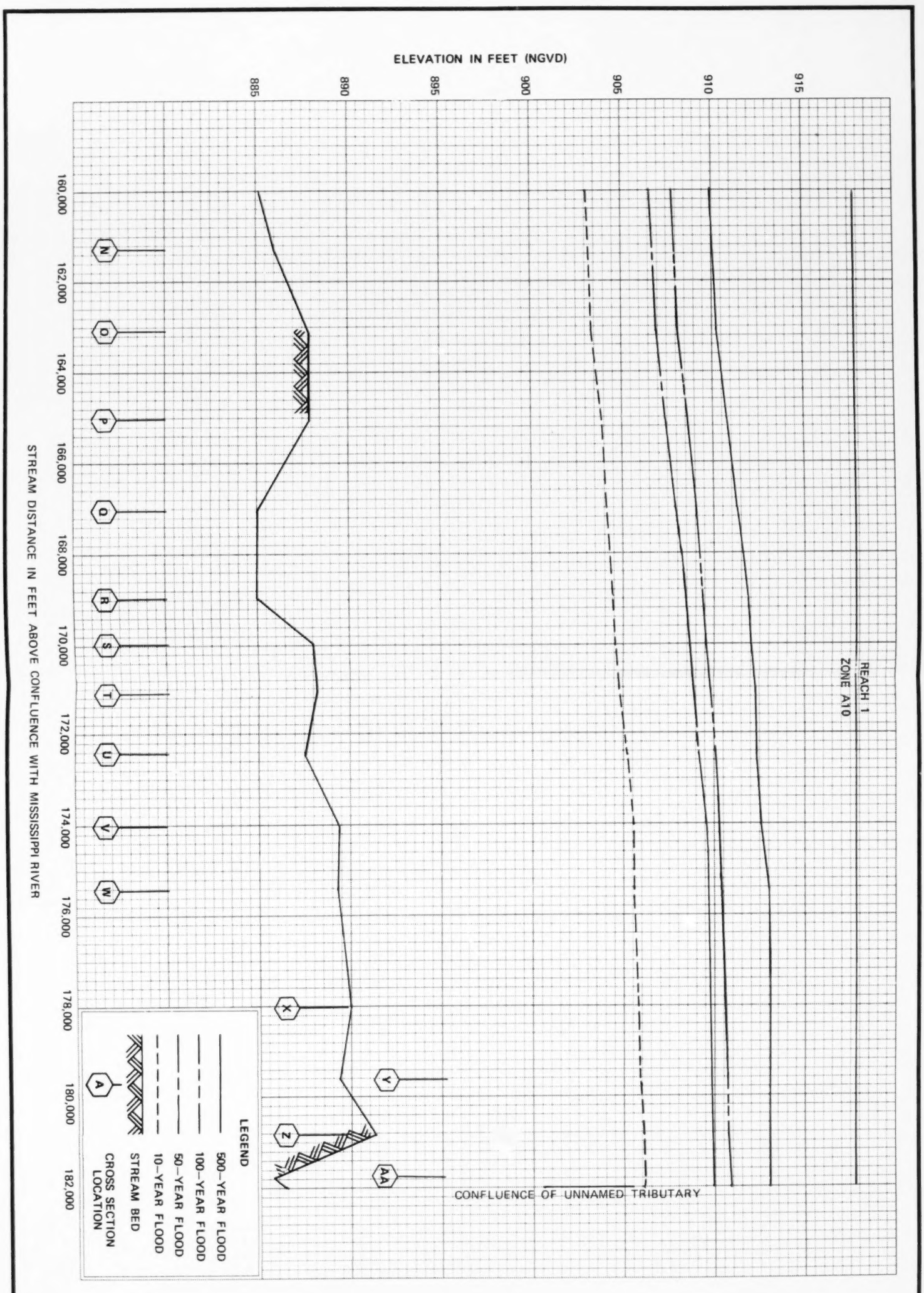
(UNINCORPORATED AREAS)

**FLOOD PROFILES**

**RUM RIVER**

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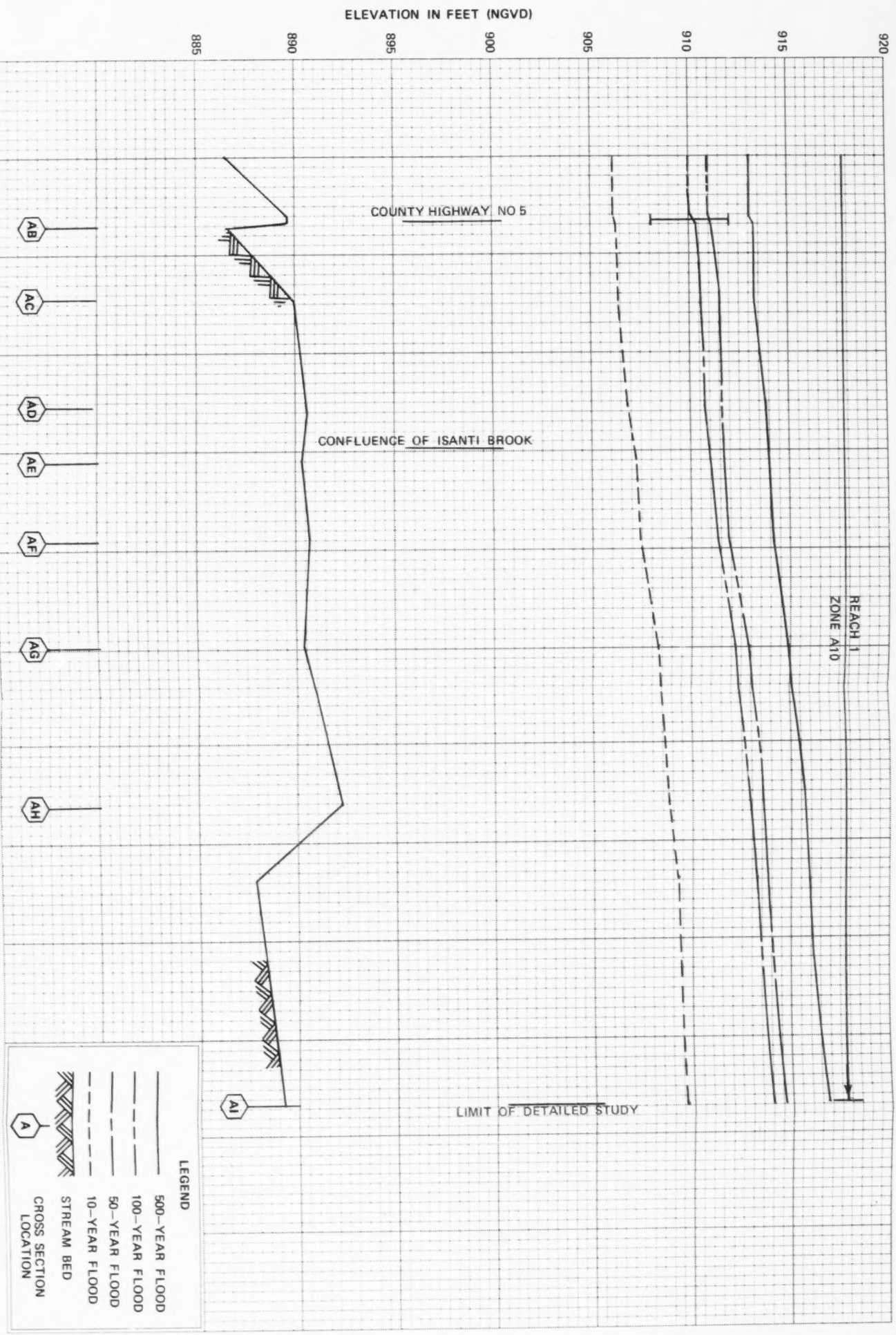
FLOOD PROFILES

RUM RIVER

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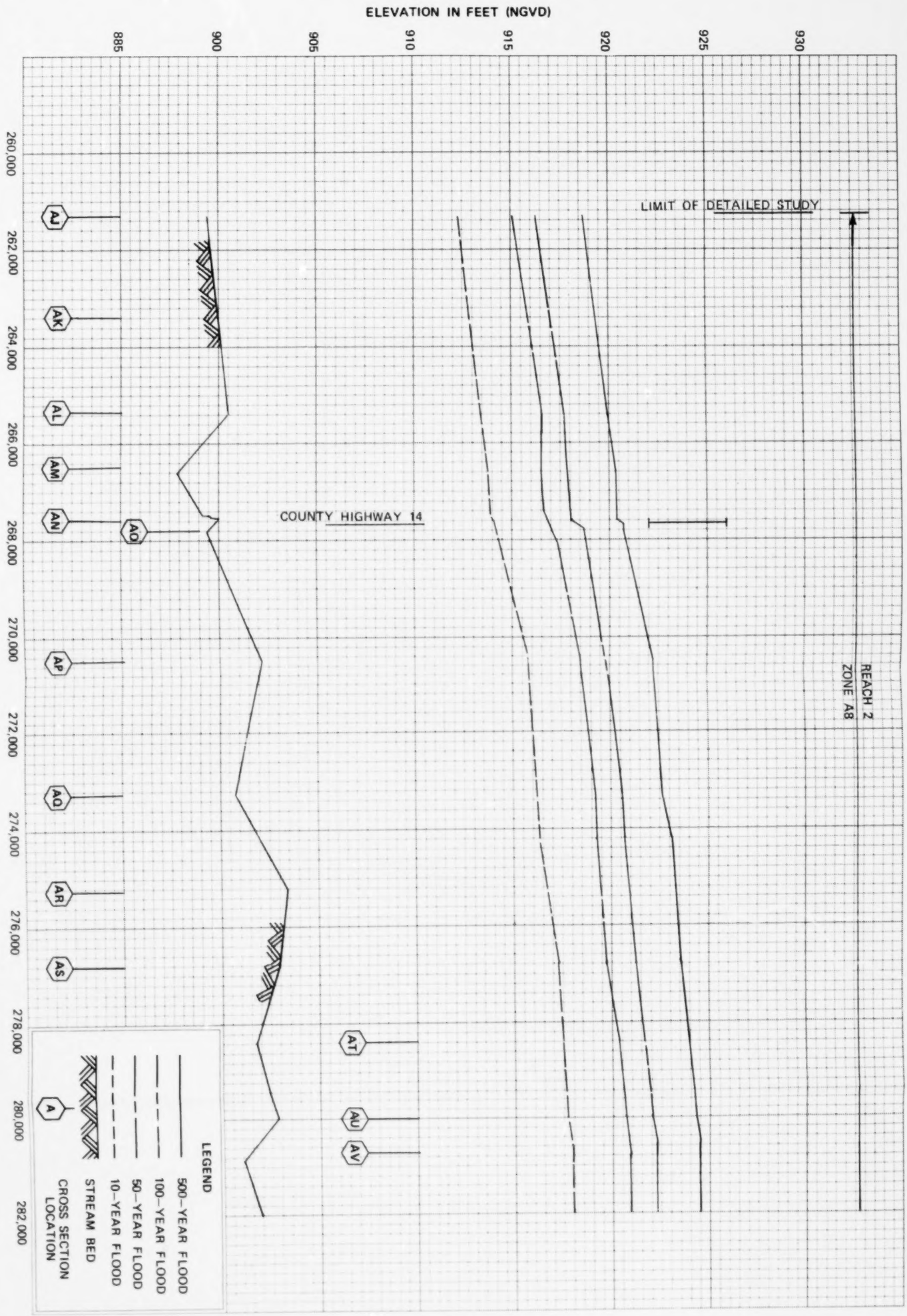
**FLOOD PROFILES**

**RUM RIVER**

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**COUNTY OF ISANTI, MN**
(UNINCORPORATED AREAS)

**FLOOD PROFILES**

**RUM RIVER**

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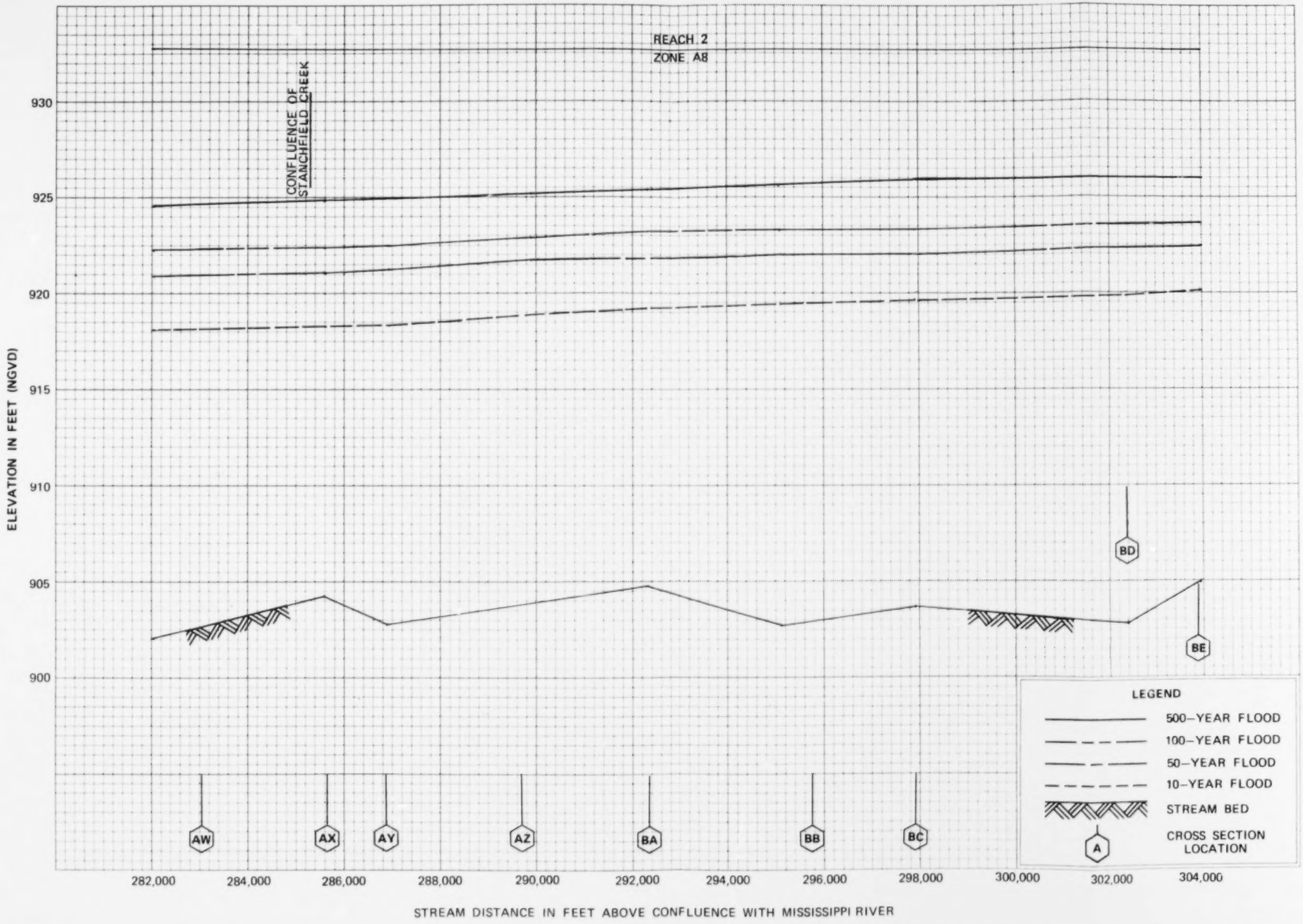


FLOOD PROFILES

RUM RIVER

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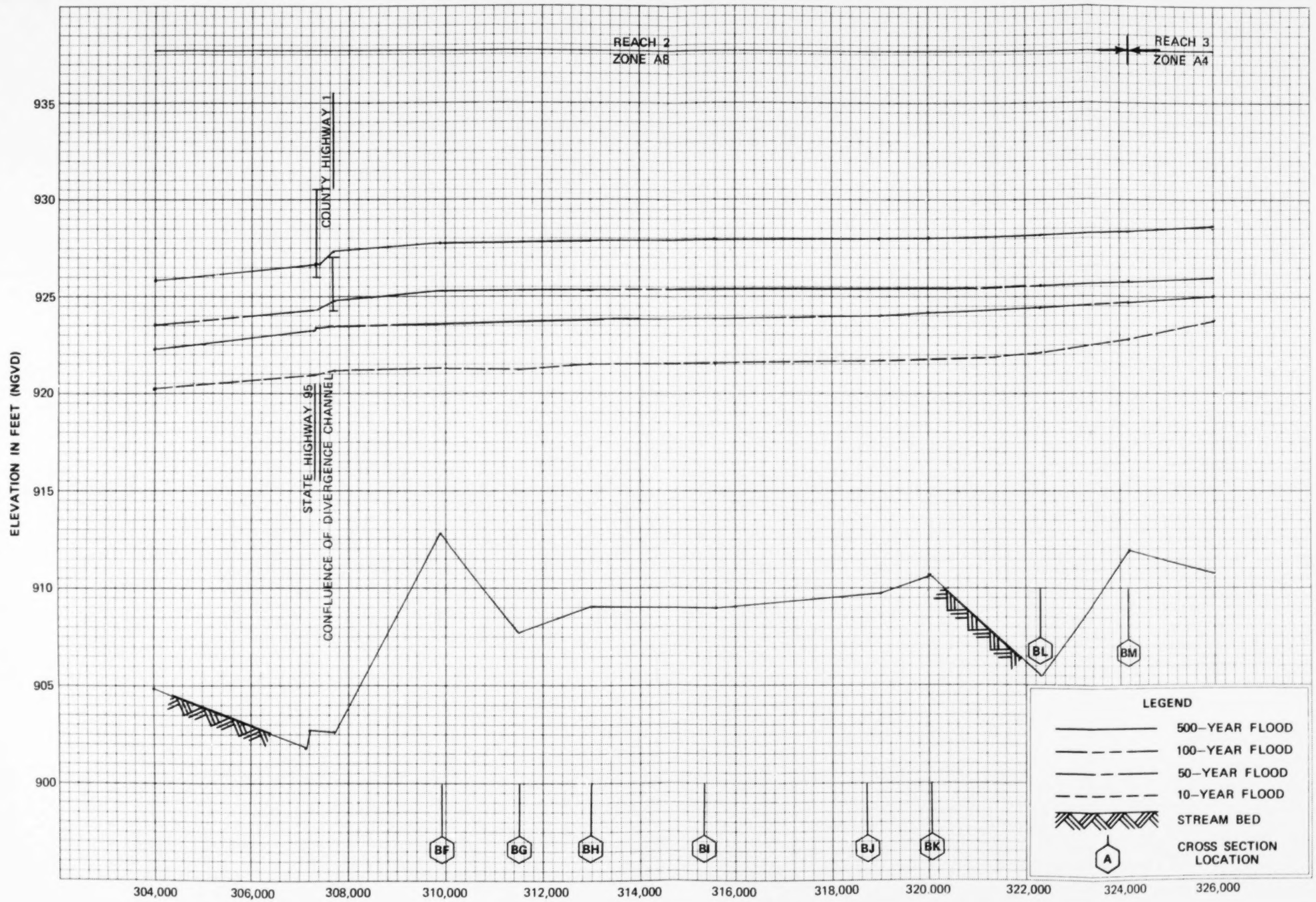


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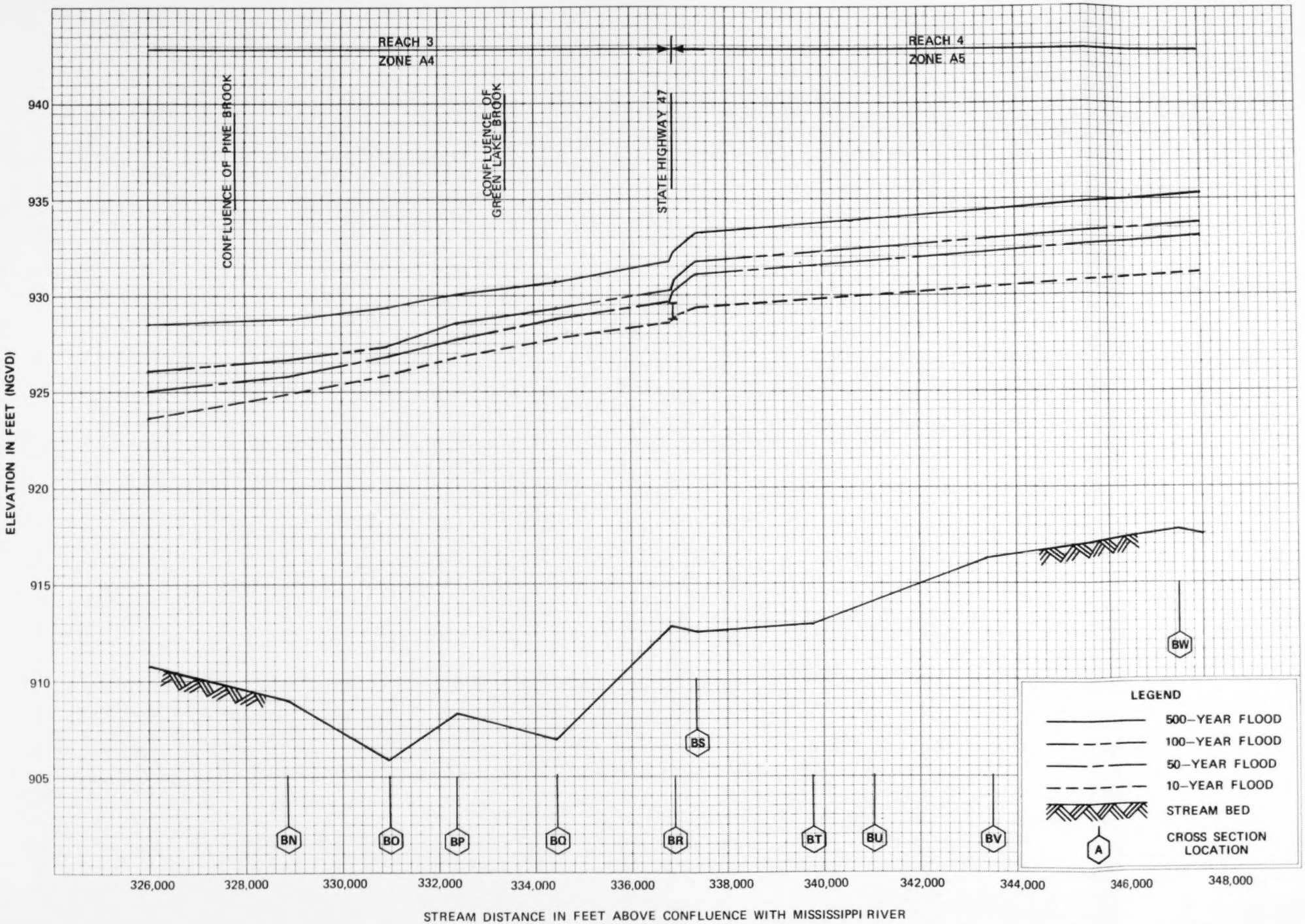


# FLOOD PROFILES

## RUM RIVER

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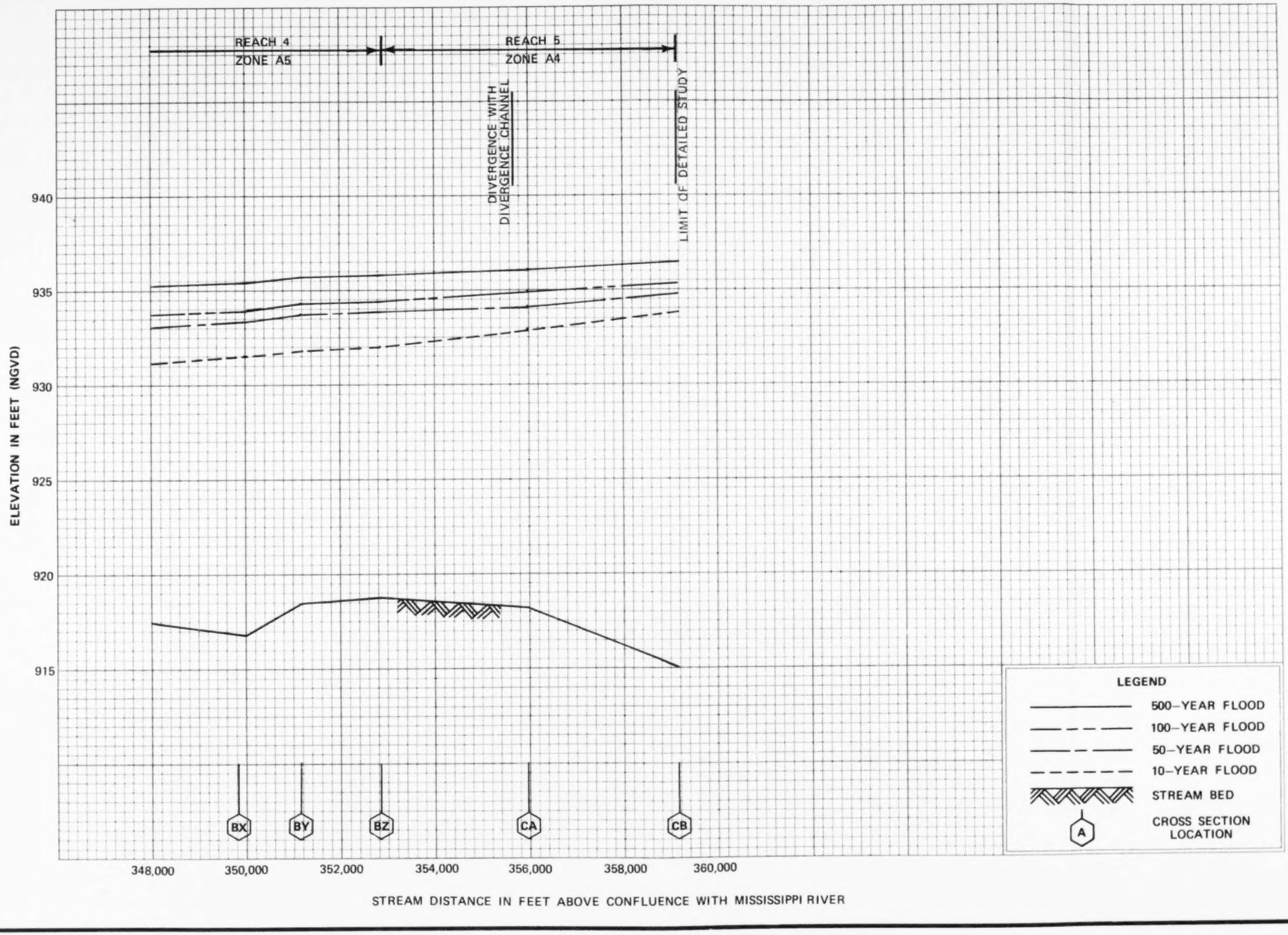


FLOOD PROFILES

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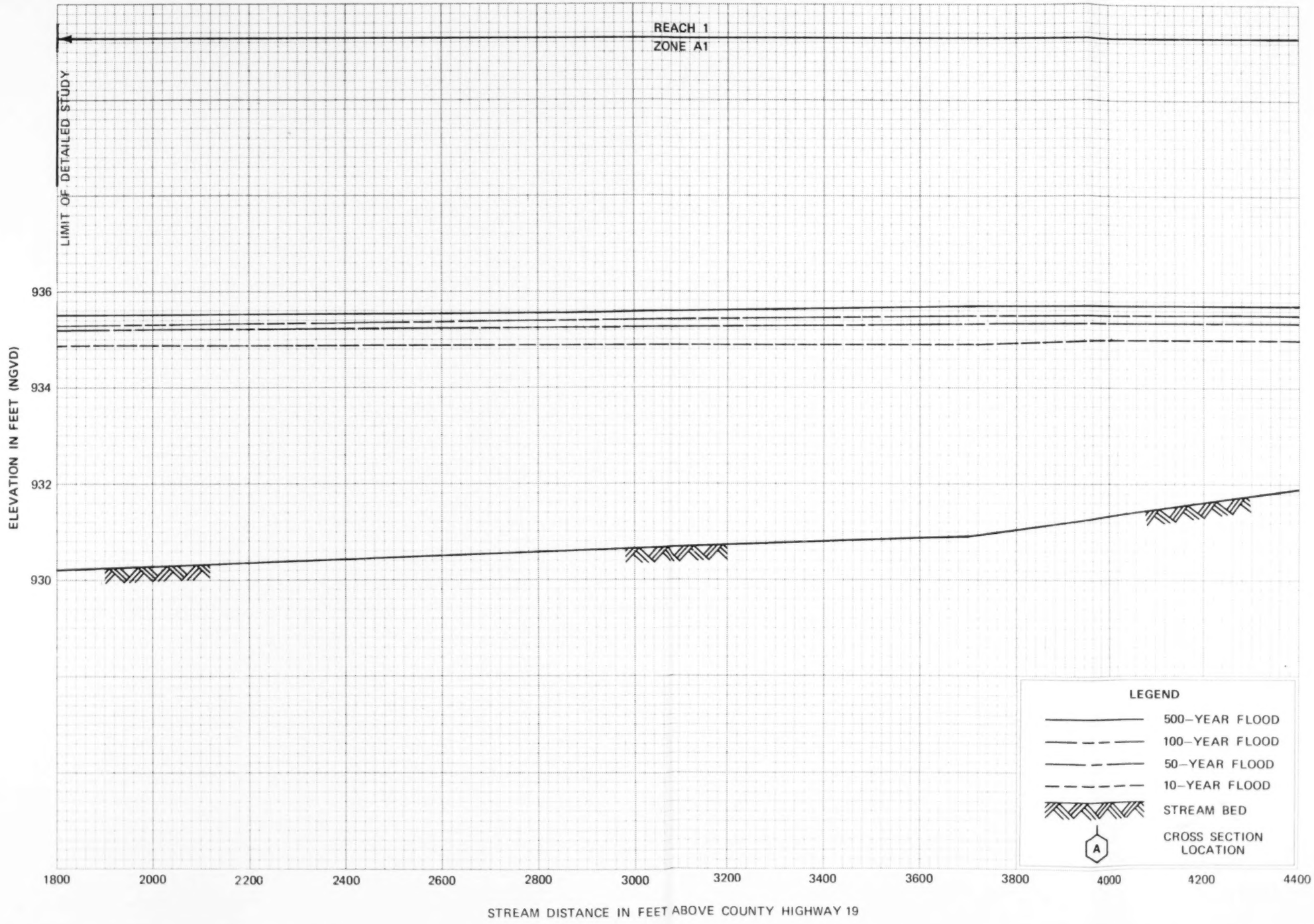


FLOOD PROFILES

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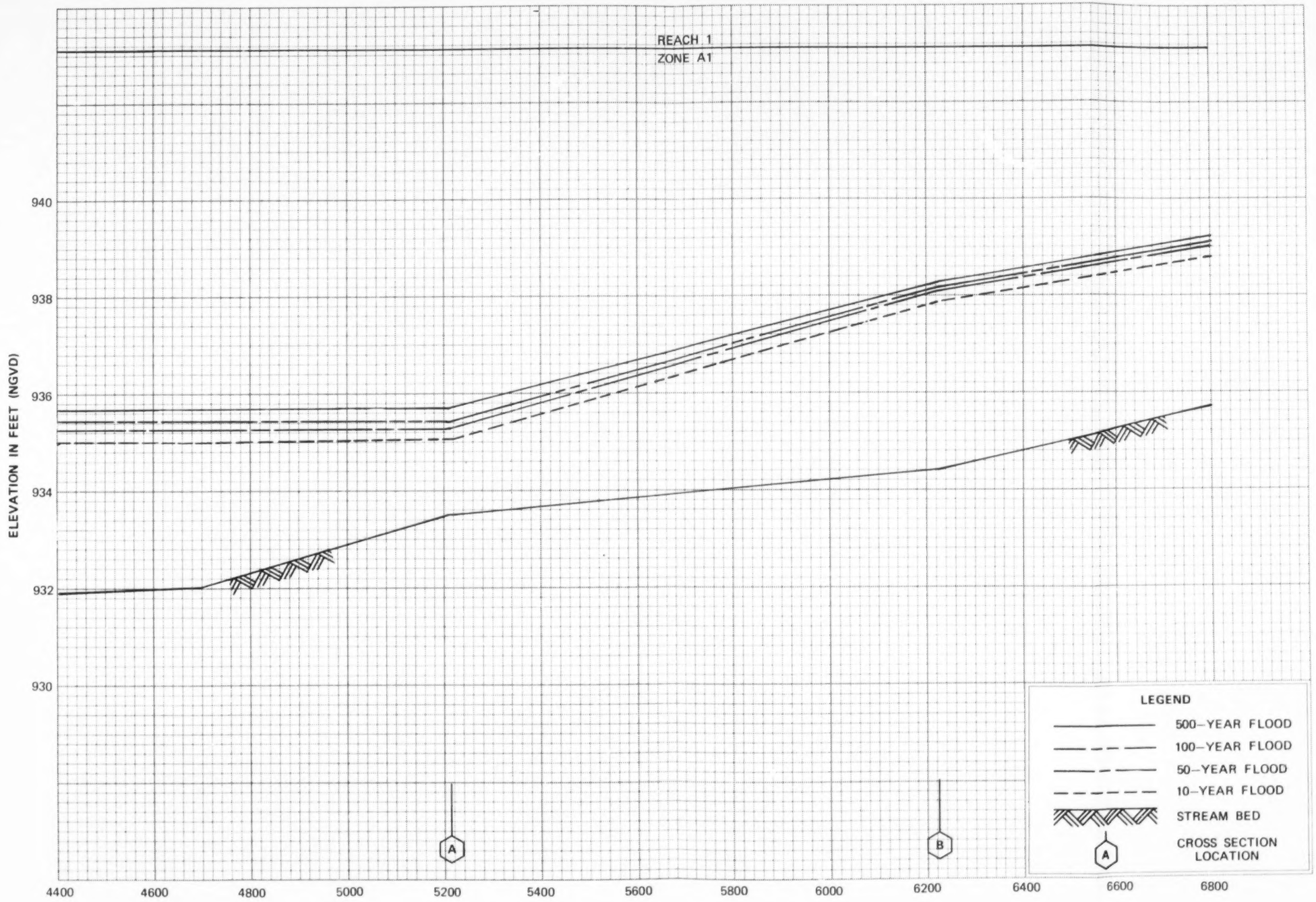


FLOOD PROFILES

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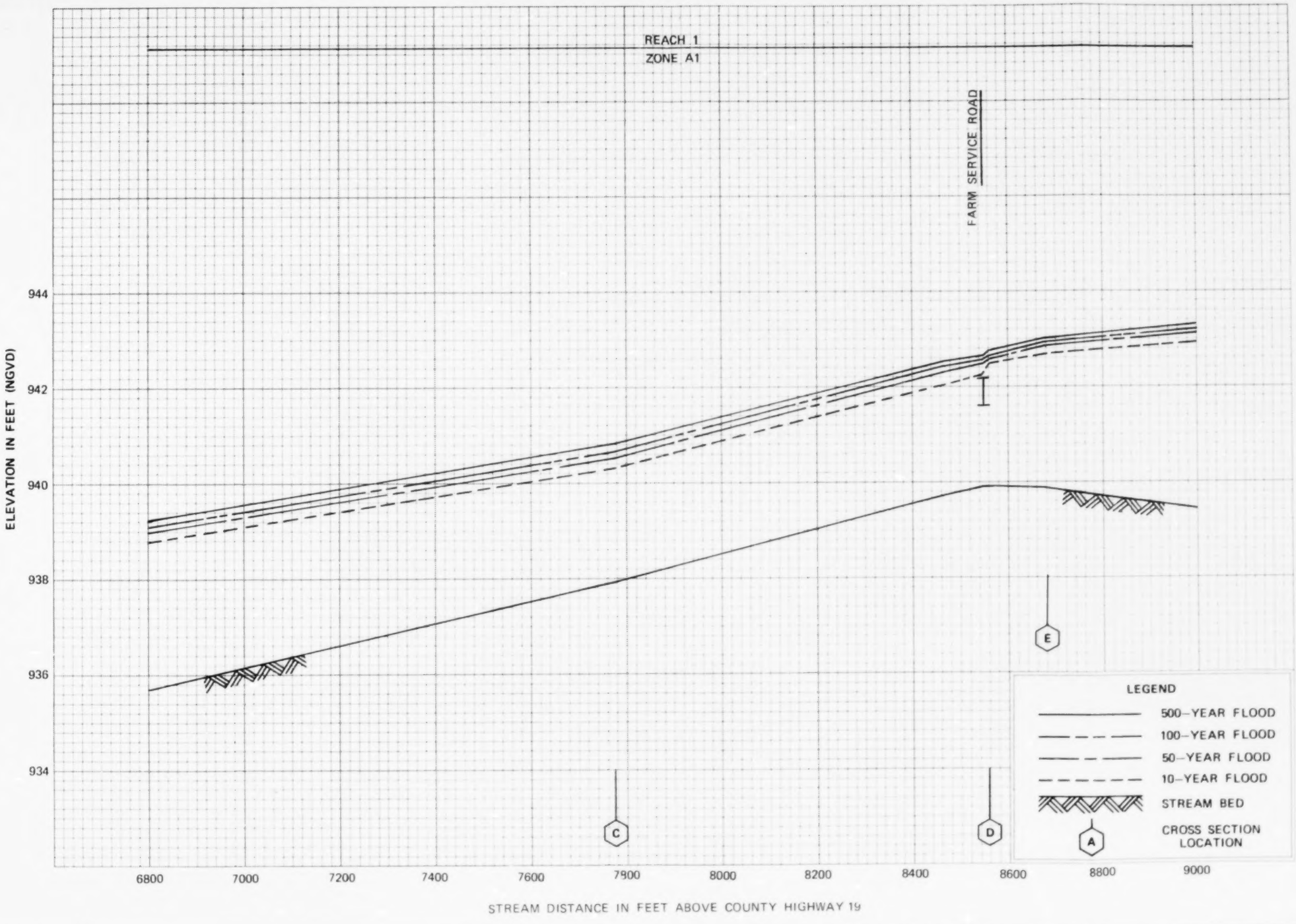


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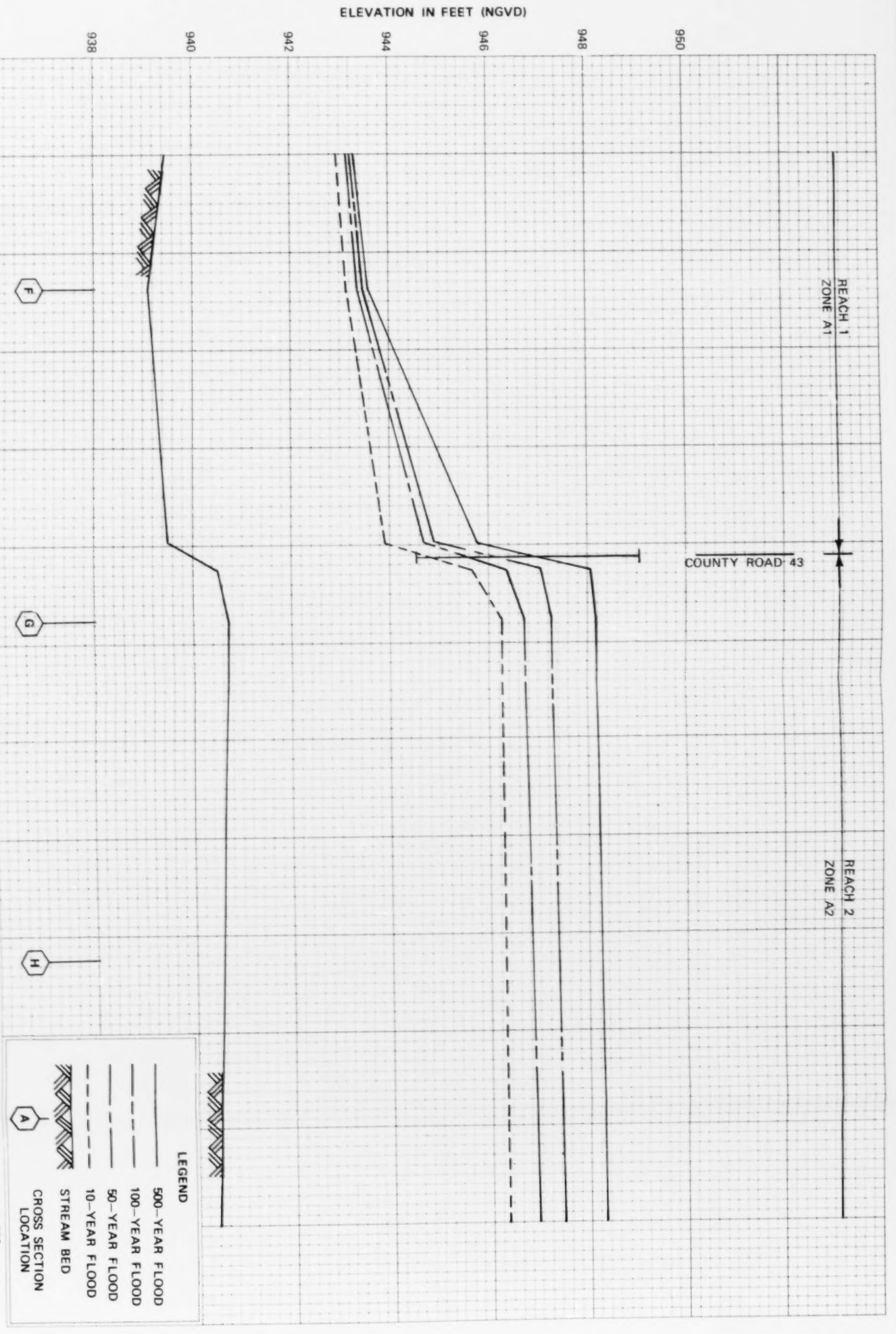


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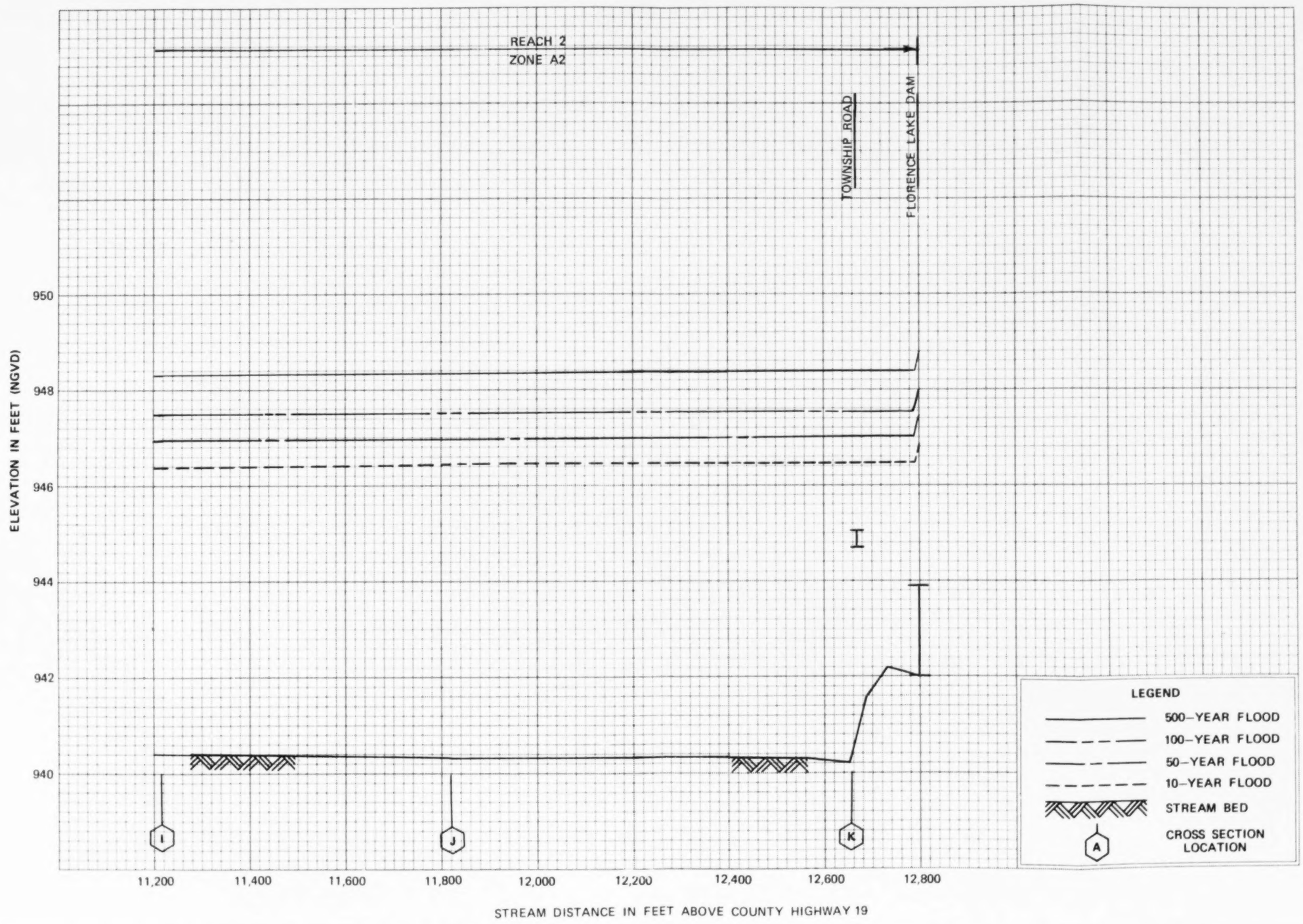


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